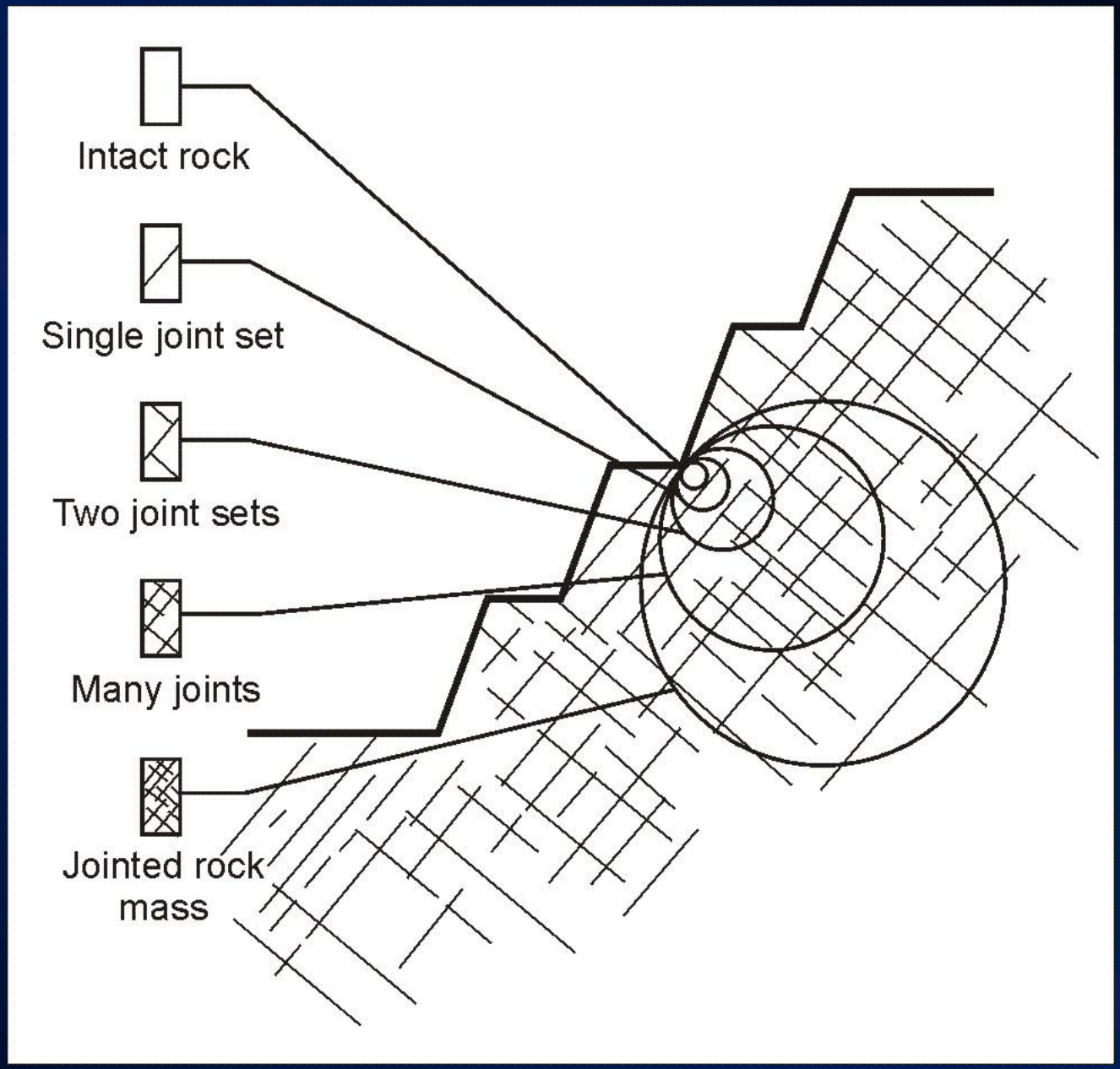
LESSON 2 – GEOLOGICAL DATA COLLECTION and STEREOGRAPHIC PLOTTING

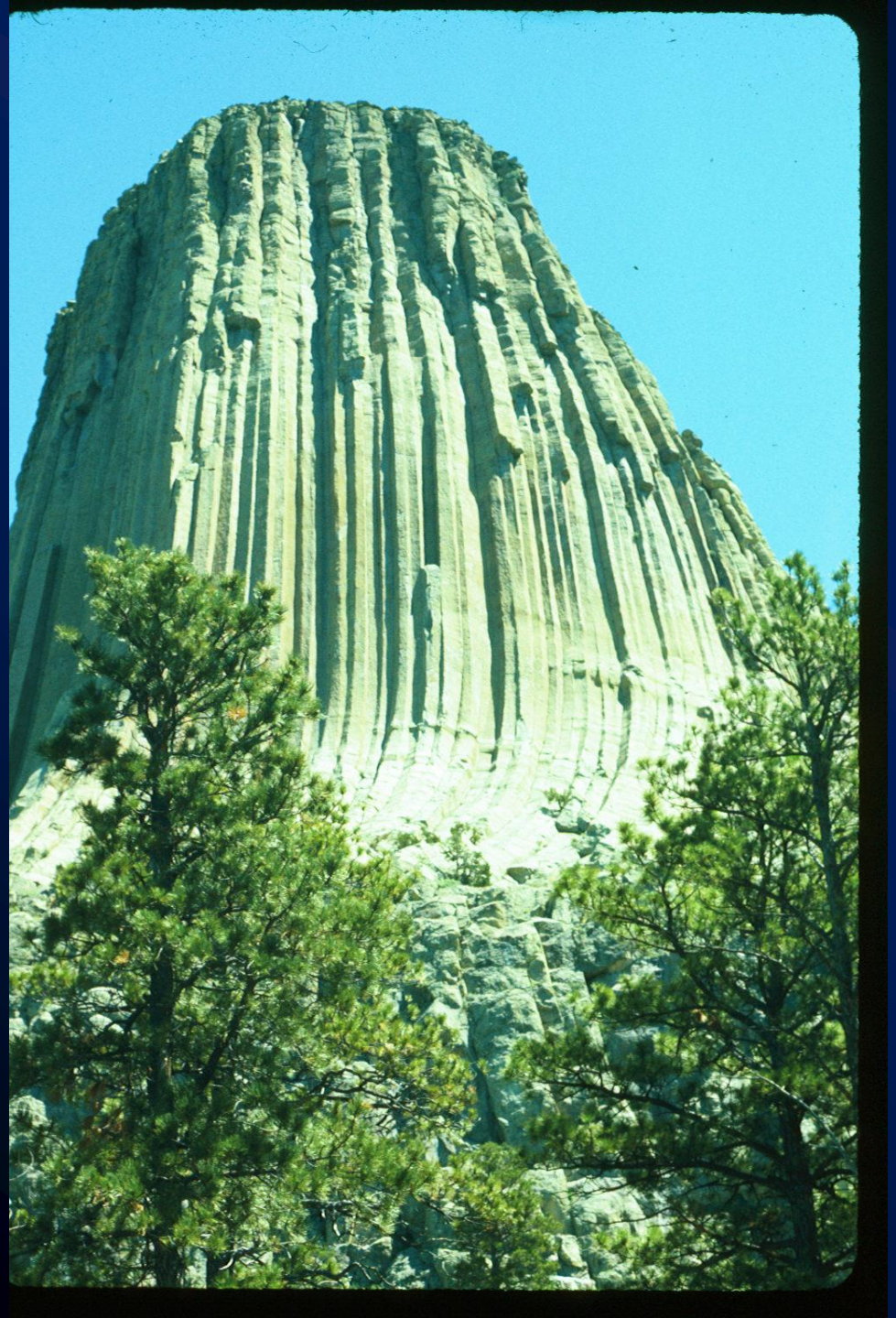
Learning Outcomes -

- ***List important geological parameters of discontinuities;***
- ***Plot and analyze structural orientation (stereonet) data.***

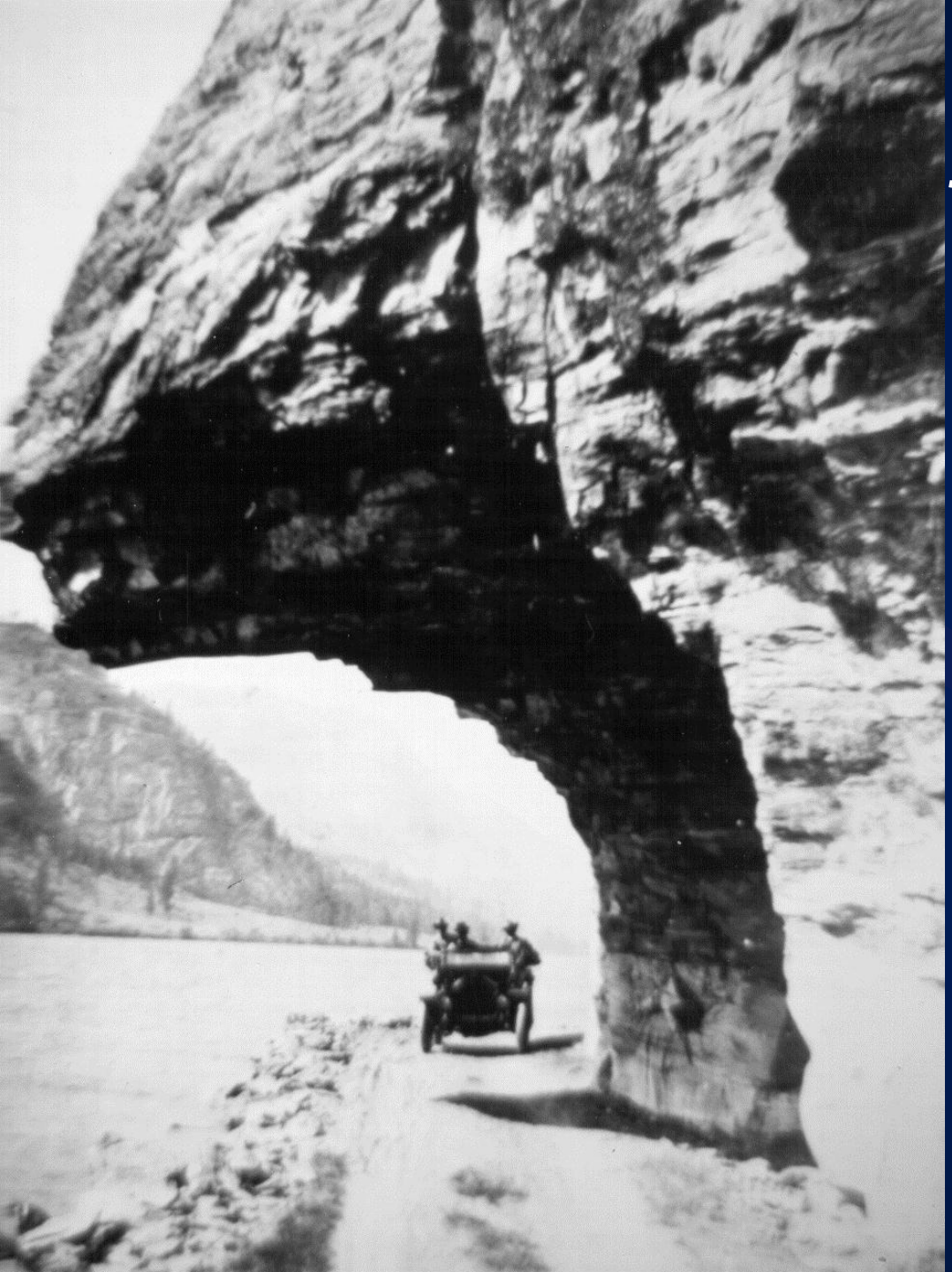


Range of rock mass characteristics.


Scale



Pervasive discontinuities
Favorably oriented



Strong rock widely spaced joints.

Unfavorably oriented discontinuities control

Definition of Geological Terms

- Standard Definitions/Procedures Necessary for:
  - Consistency and Compatibility Between Different Data Collectors
  - Facilitate Communication Between Different Parties
  - Quantitative Basis for Engineering Evaluation and Analysis
  - Completeness in Data Collection

Definition of Discontinuity Parameters

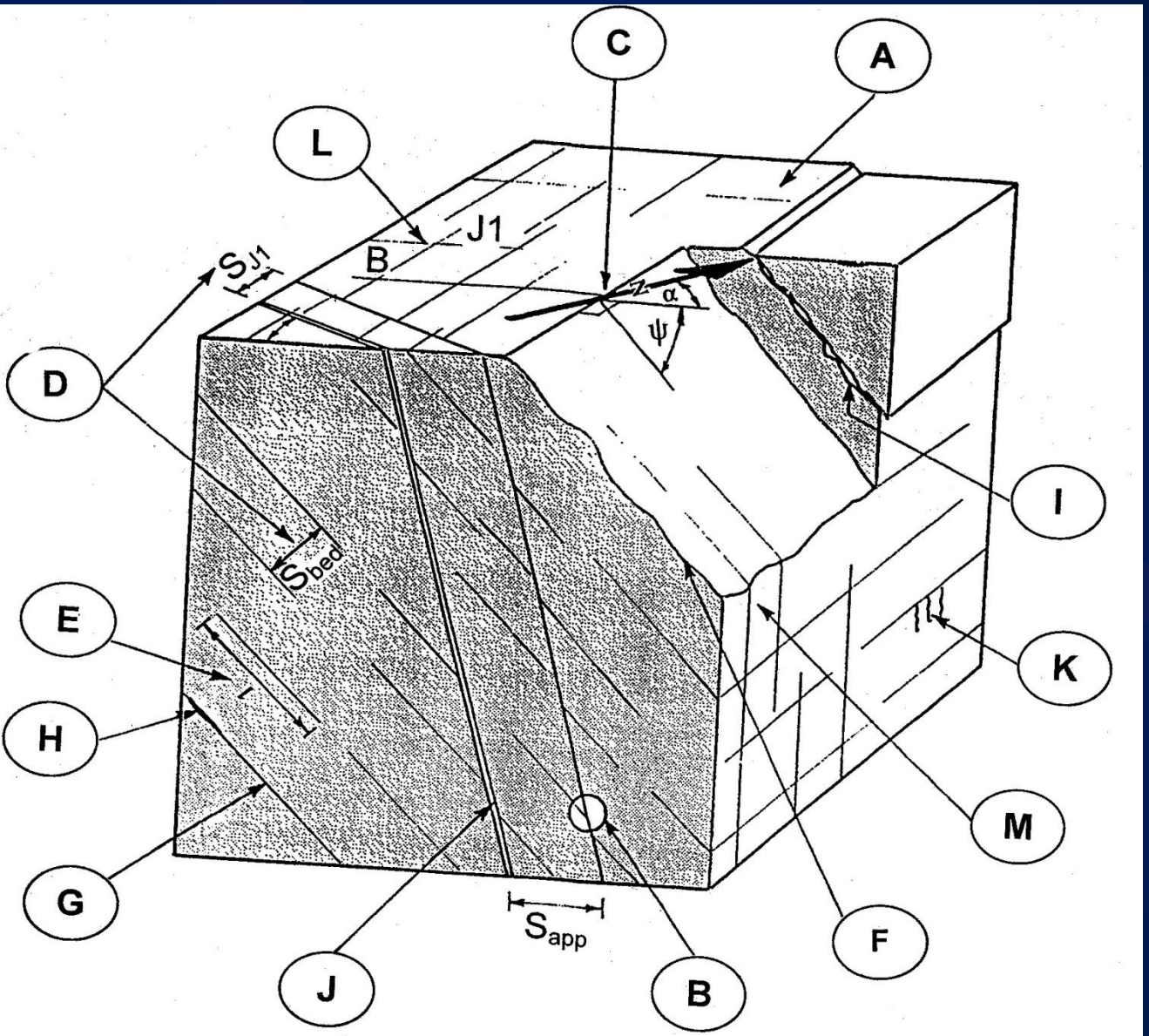


Figure 2-2
Page 2-6

A. - Rock Type

- *Deere and Miller*
- *Colorado School of Mines Quarterly (Russell B Travis)*

B Discontinuity Type

- ***Contact*** *- (Continuous and Sometimes Low Shear Strength e.g. Weathered Paleosurface Dipping into Cut)*
- ***Fault/Shear*** *- (Continuous, Potentially Low Shear Strength)*
- ***Joint*** *- (Cooling in Basalt, Tectonic Effects Sedimentary/Igneous)*
- ***Bedding*** *- (Sedimentary Layering)*

B Discontinuity Type (cont'd)

- ***Flow Banding*** *- (Igneous Flows; May Not be Weakness)*
- ***Foliation/Schistosity/Cleavage*** *- (Metamorphic Layering)*
- ***Vein*** *- (Includes "Healed Joints" - May Not be Weakness)*

Joints are controlling discontinuities

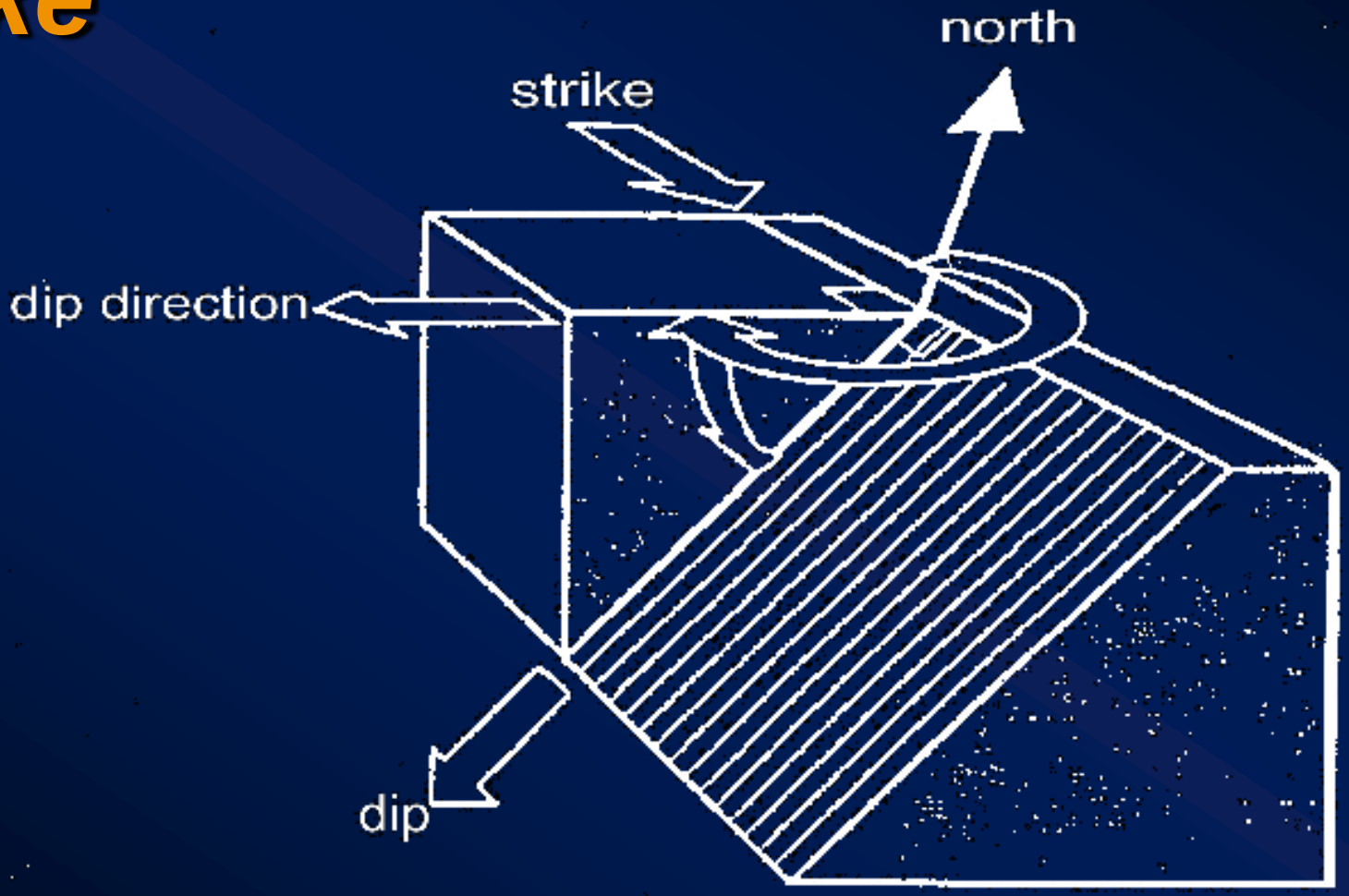
Bedding is controlling discontinuity

I40, NC/TN

C Discontinuity Orientation

- ***Dip*** *- Angle of Steepest Inclination of Plane, Measured Below Horizontal* ***(two digits 00 to 90)***
- ***Dip Direction (Dip Azimuth)*** *- Azimuth of the Line of Dip* ***(three digits 000 to 360)***
- ***Strike*** *- Azimuth of a Horizontal Line (90 Degrees to Dip Direction) - Unsuitable for Rock Slope Engineering*

Definition of Dip, Dip Direction, Strike



Planar Features

Structural Compass

D Discontinuity Spacing

- *Measure True Spacing in Surface Mapping*

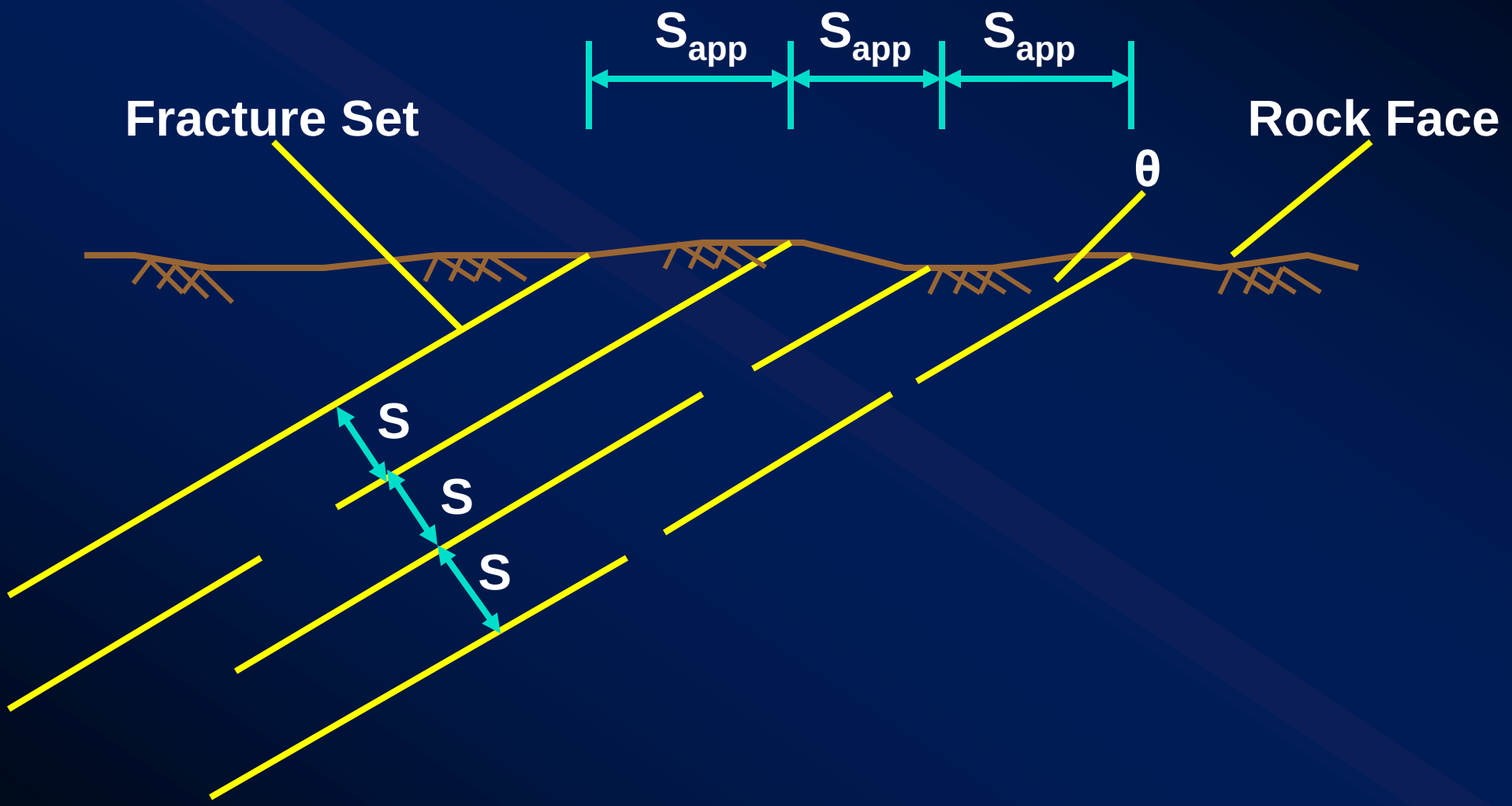
  Range:

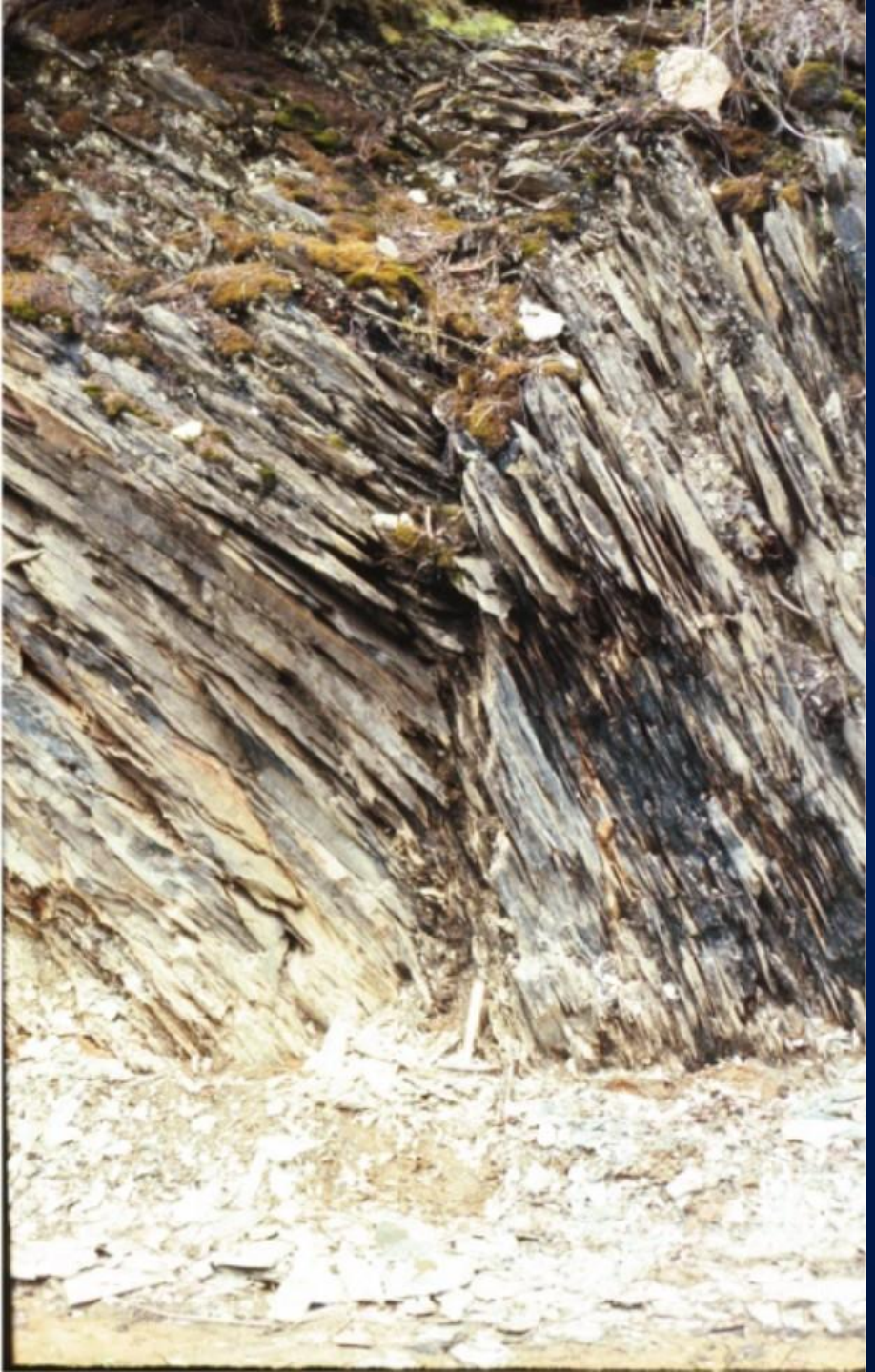
  Extremely close spacing (<20 mm)

  Extremely wide spacing (>6000 mm)

- *Line Mapping or Coreholes: Use Terzaghi Correction for True Spacing*

True and Apparent Spacing





Extremely close foliation spacing

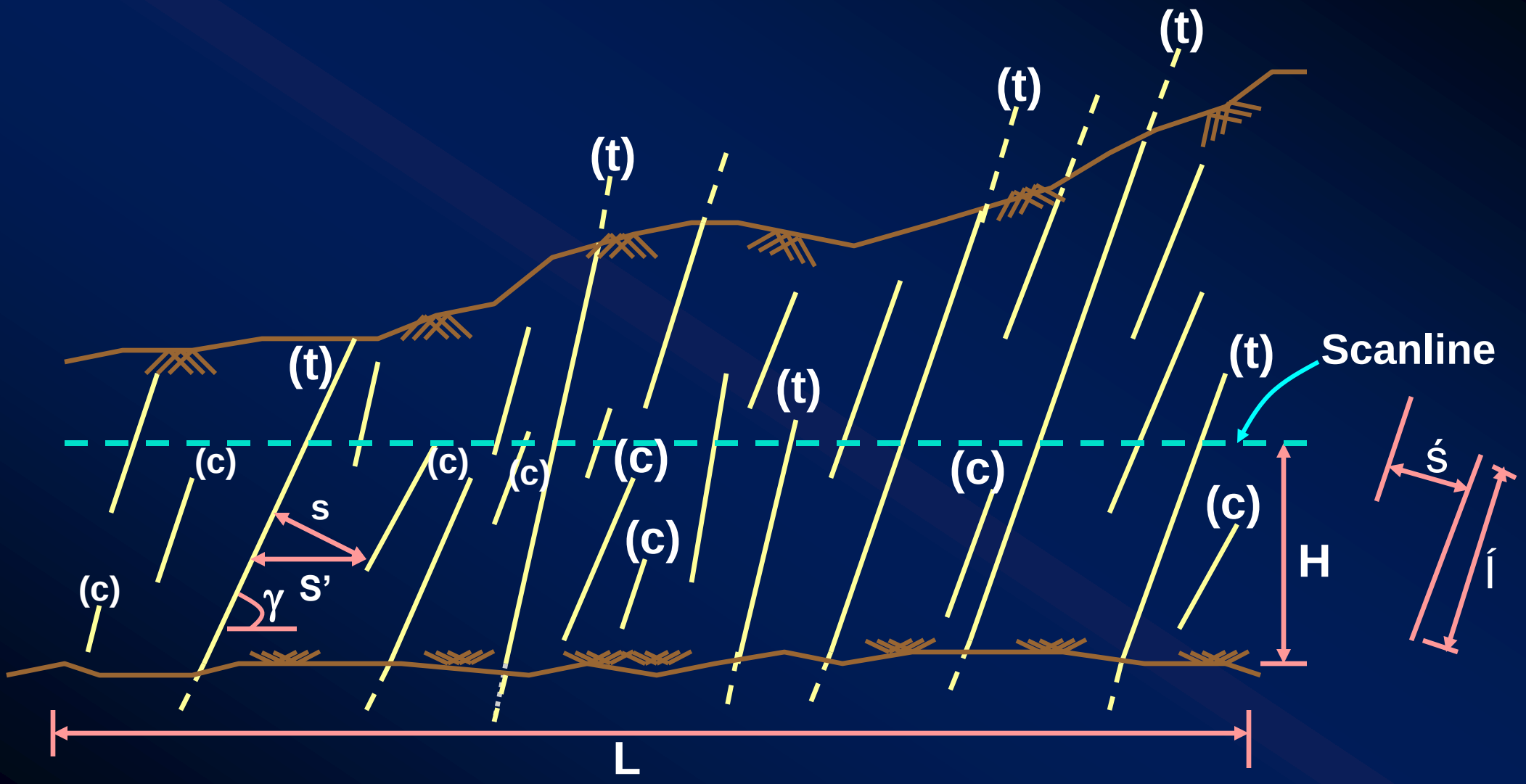
Will strongly influence rock mass:

- ***strength***
- ***deformability***
- ***permeability***
- ***excavatability***

E Persistence

- Document Visible or Inferred Length
  - Range:
    Very low (<1 m)
    Very high (>20 m)
- Document Termination of Joints (0, 1, 2)
- Statistical Estimates of Length Distribution (e.g. Pahl, page 2-8)
- Persistence cannot be Measured in Core

Measurement of Persistence



Persistence of family of faults will control abutment design

F Irregularity/Roughness

- **Descriptive**

  Shape:

  - Stepped
  - Undulating
  - Planar

  Roughness:

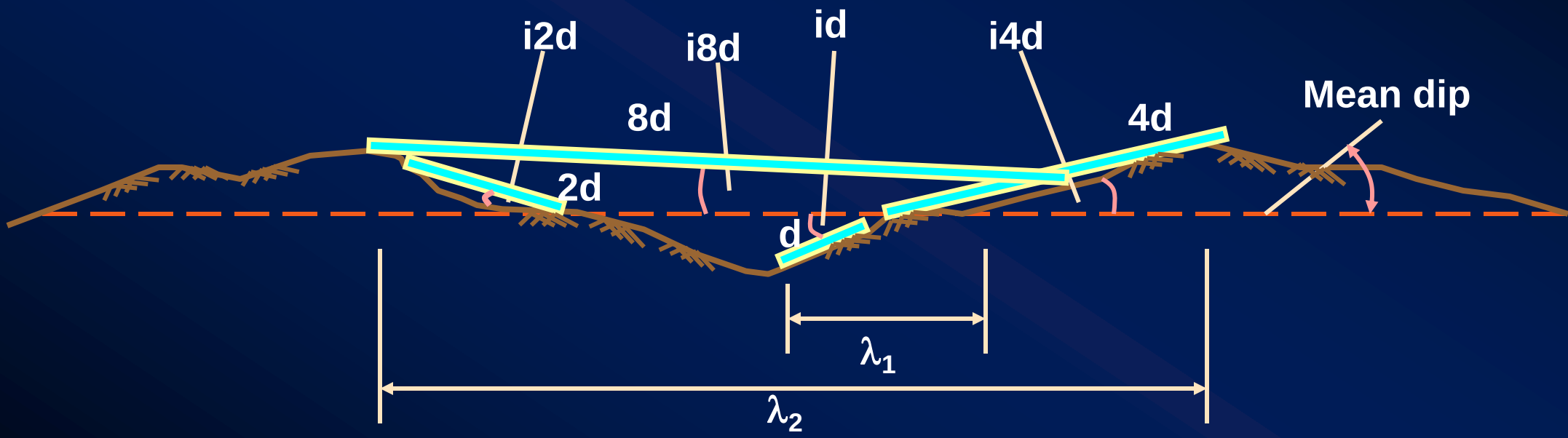
  - Rough
  - Smooth
  - Slickensided

- **Semi Quantitative - Joint Roughness Coefficient (JRC)**

Rough Undulating	JRC 20	e.g. Tension Joints
Smooth Undulating	JRC 10	e.g. Foliation/Joints
Smooth Planar	JRC 5	e.g. Bedding

Discontinuity Roughness Measurement

Quantitative approach

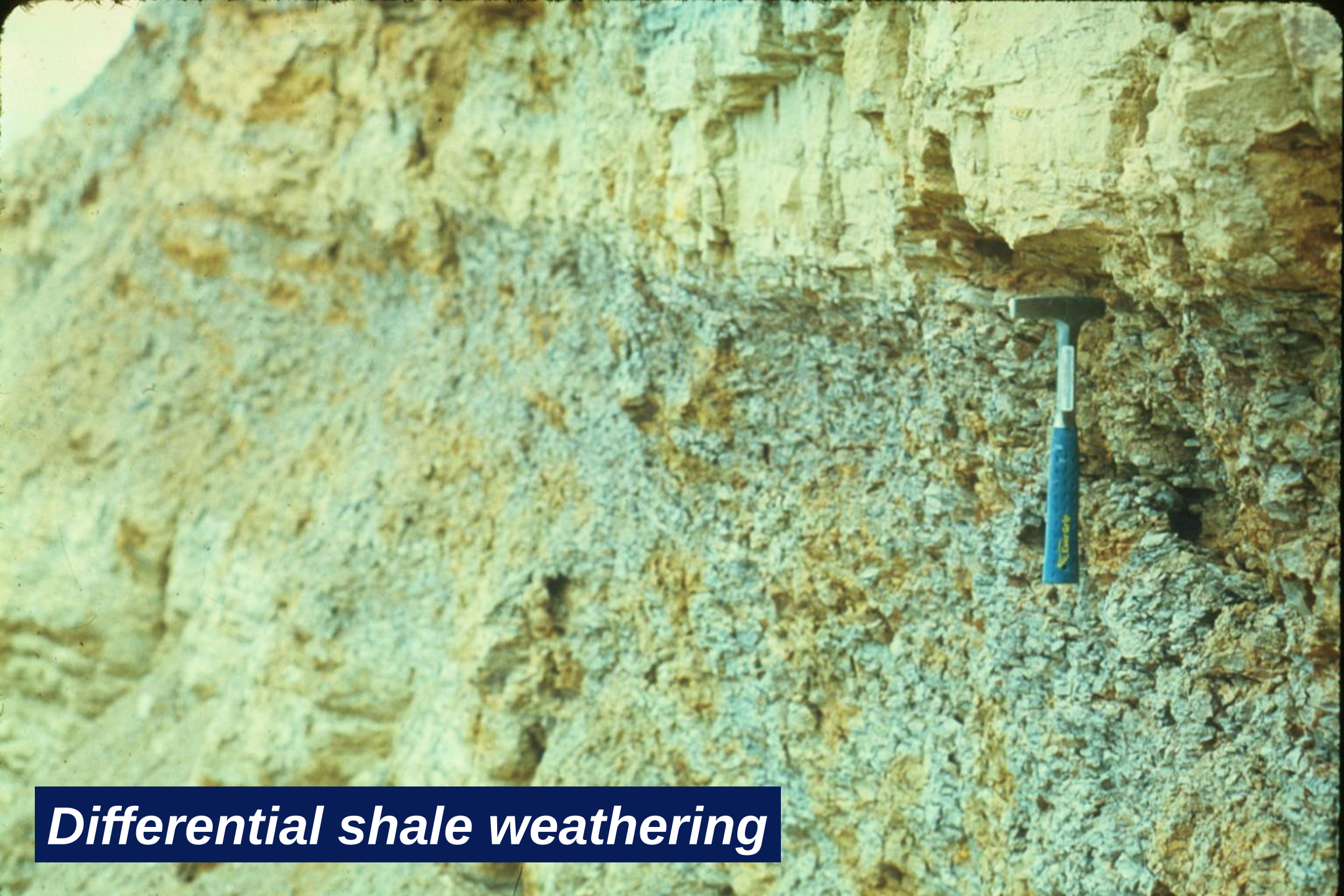


G Wall Rock Strength - (Joint Compressive Strength - JCS)

- *Estimate Compressive Strength Based on:*
  - *Field Classification (ISRM) - Table 2-1:*
    Range:
    Extremely weak (0.25-1MPa)
    Extremely strong (>250 MPa)
  - *Field Testing (Point-Load Test or Schmidt Hammer)*
  - *Laboratory Testing*

H Weathering

- ISRM Weathering Classification - Table 2-2
  - Fresh
  - Slightly weathered
  - Moderately weathered
  - Highly weathered
  - Completely weathered
  - Residual soil



Differential shale weathering

Chemical decomposition

I Aperture

- ***Measure Directly, Table 2-1:***

  Range:

  - ***Very tight (<0.1 mm)***
  - ***Cavernous (>1000 mm)***

J Filling/Width

- *Measure Width (Table 2-2)*
- *Characterize Wall Rock*
- *Infilling Characteristics*
  - *Mineralogy*
  - *Particle Size*
  - *Water Content*
  - *Stiffness*


25 mm thick, continuous clay
infillings (bedding plane shears)

Controlling structure for slope design

Rocky Point Viaduct, OR

K Seepage

- Document According to Field Sheets
  - Tight and dry
  - Dry
  - Dry, rust staining
  - Damp
  - Seepage, drops
  - Continuous flow

L Number of Joint Sets

- **Number of Systematic Joint Sets**
  - Often three orthogonal sets
  - Maximum four or five sets
  - Record faults and shears separately from joints and bedding

M Block Size/Shape

- Use code on Data Collection Sheet

SHAPE	SIZE
- Blocky	Very large (>8 m^3)
- Tabular	Large (0.2 – 8 m^3)
- Columnar	Medium (0.008-0.2 m^3)
- Shattered	Small (0.0002 – 0.008 m^3)
	Very small (<0.0002 m^3)

Blocky structure

Refer to Figure 2-2 of Reference Manual on page 2-6

Geotechnical Mapping

- *Line Mapping*
  - *Documenting All Structures that Intersect a Tape or Painted Scan Line*
- *Window (Cell) Mapping*
  - *Document All Structures Within a Representative Areas or "Windows"*

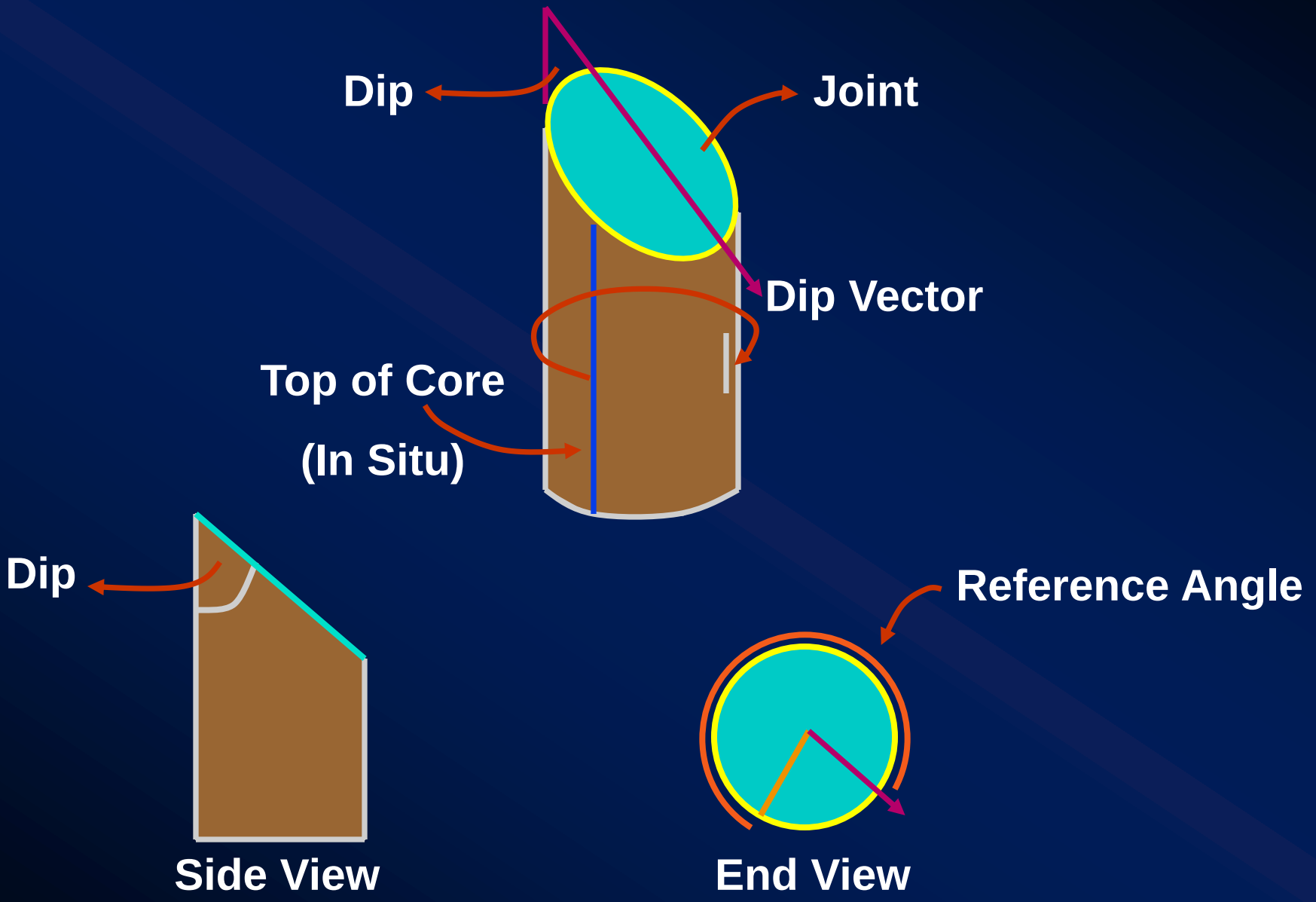
Geotechnical Drilling

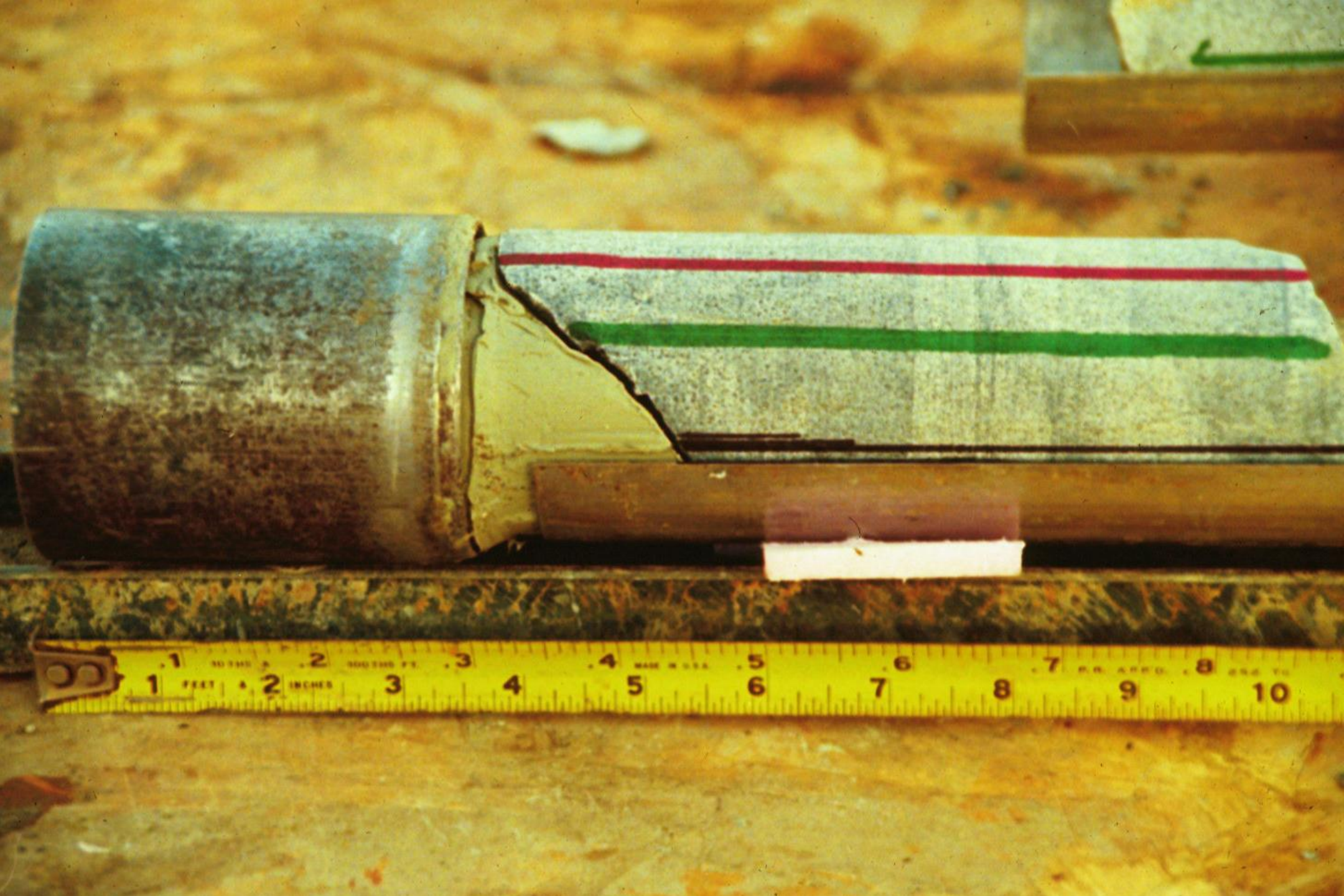
Diamond Drilling

- Triple Tube or Double Tube with a Split Inner Tube
- Geotechnical Logs - RQD, Recovery, Fracture Frequency, Joint Angle (Cornerstone of Communication !!!)
- Core Photographs & Core Handling
- Structural Orientation Data from Drilling
  - Oriented Coring - Clay Impression Method
  - Borehole Imaging

Core Photographs

Core Orientation – Reference Line

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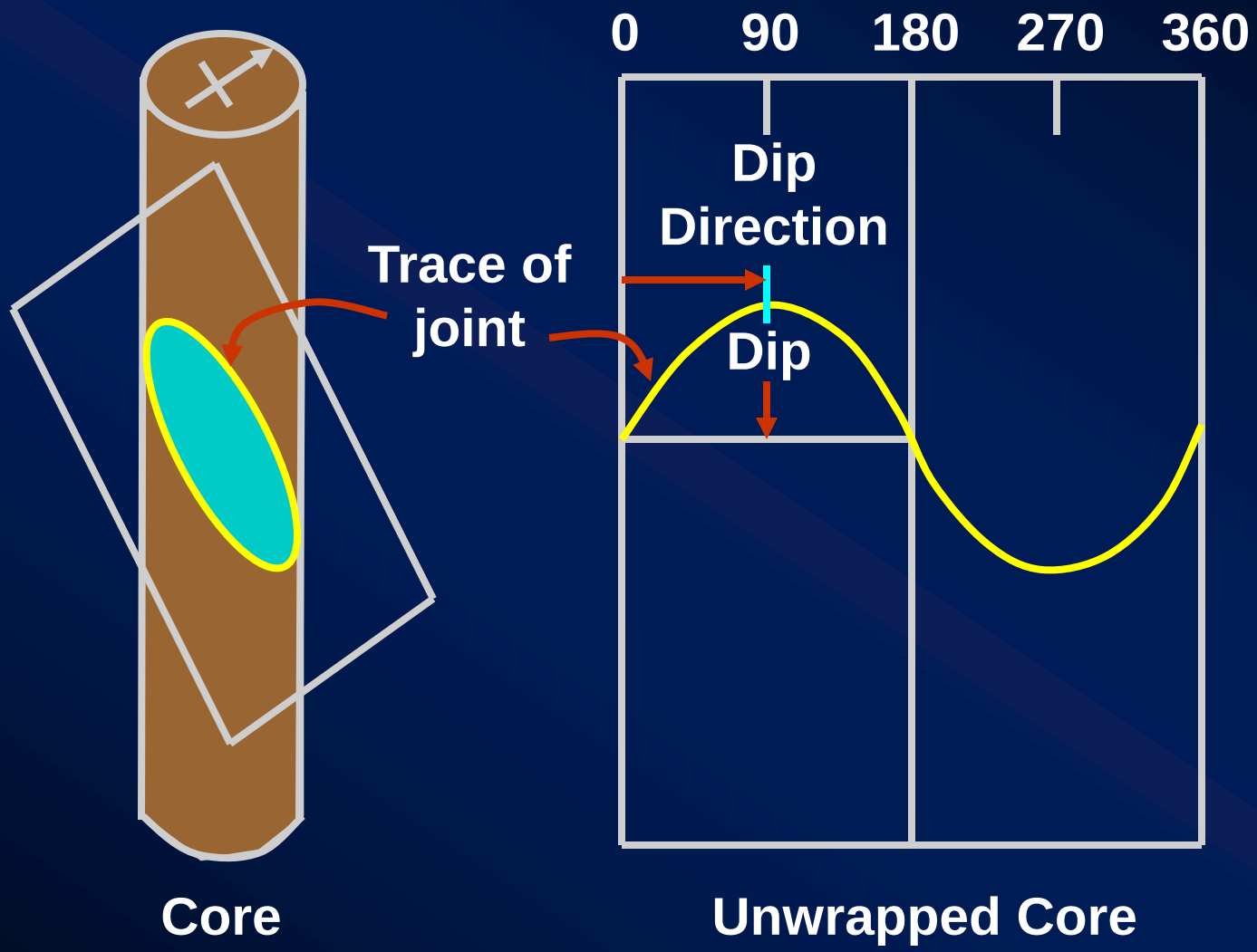
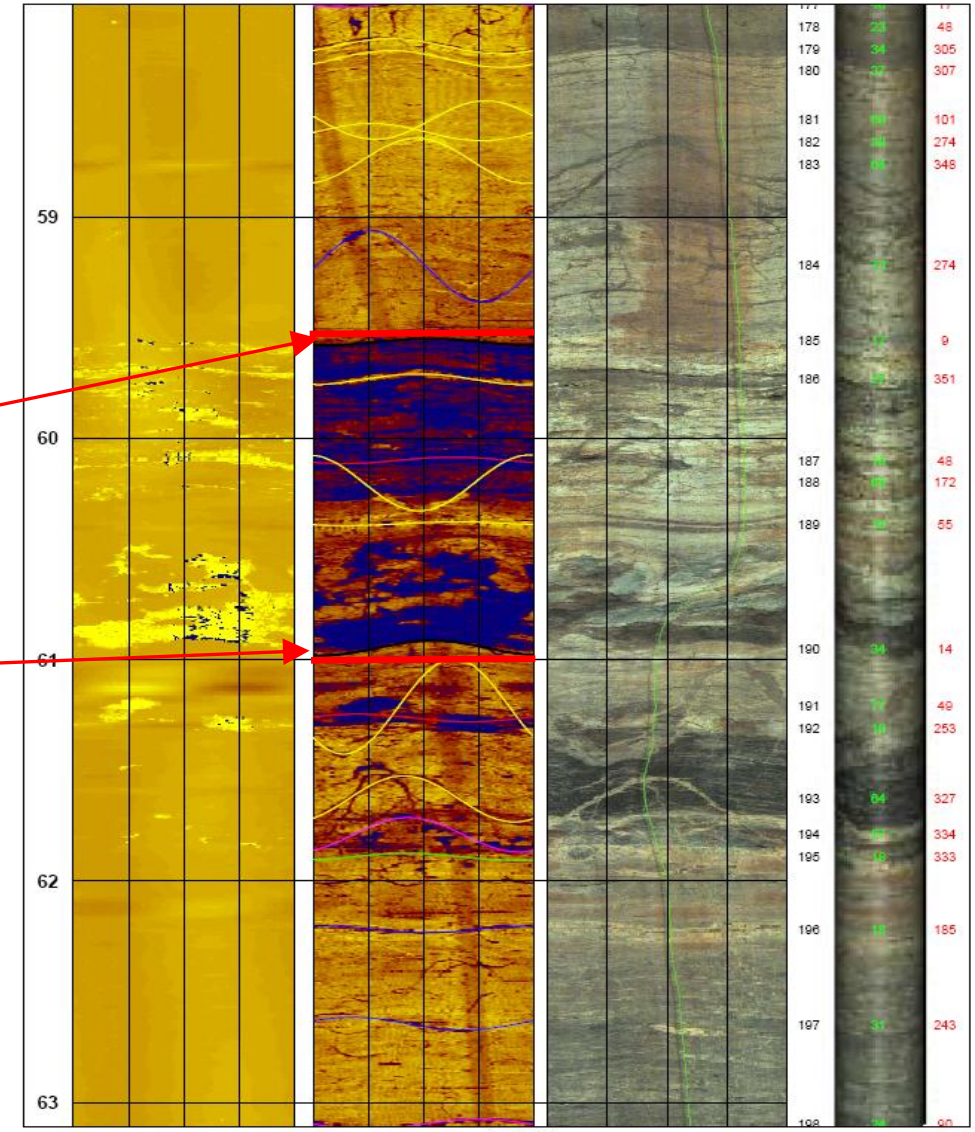
Borehole Televiewer Logging

Core Orientation – Borehole Camera



Comparable section of core quality and televiewer data.



Acoustical Log | *Optical Log* | *id#* | *Dip* | *DDR*

Borehole Televiewer Logging

DDR = dip direction

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